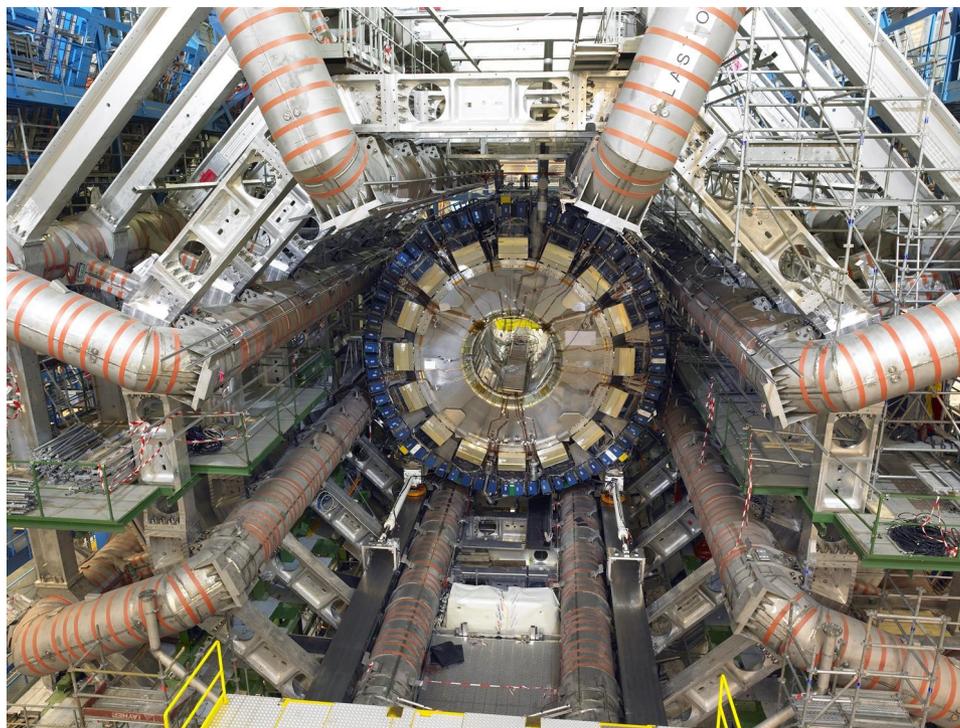


Studies of the dynamic range of TileCal cells in high- p_T jets



Jordan Dull

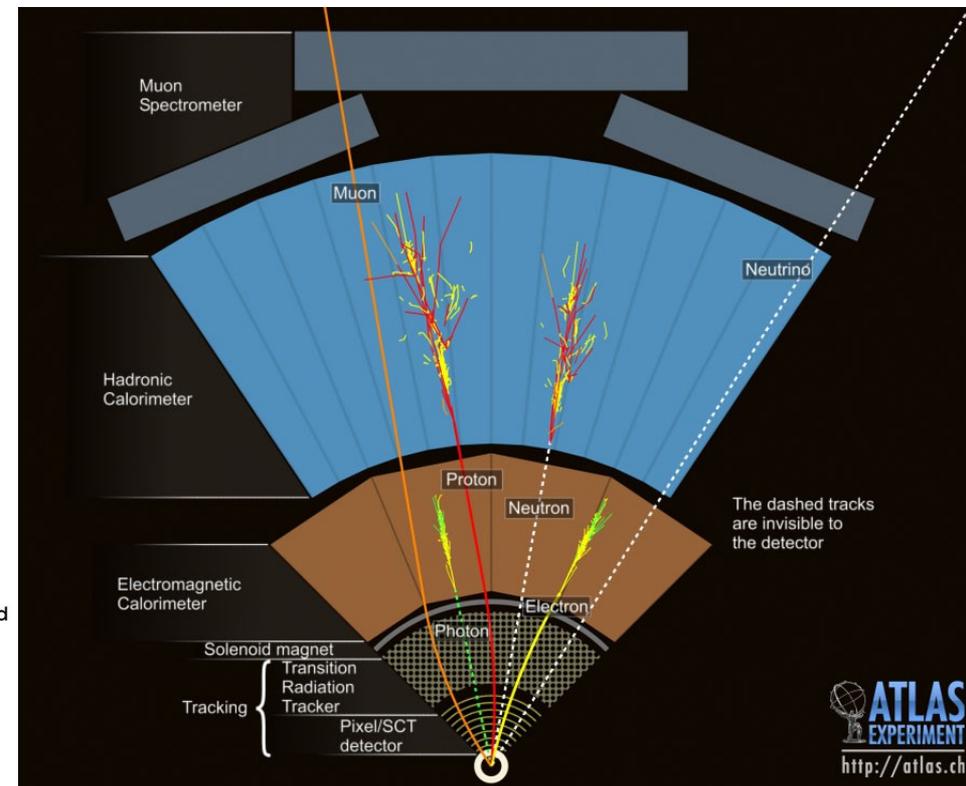
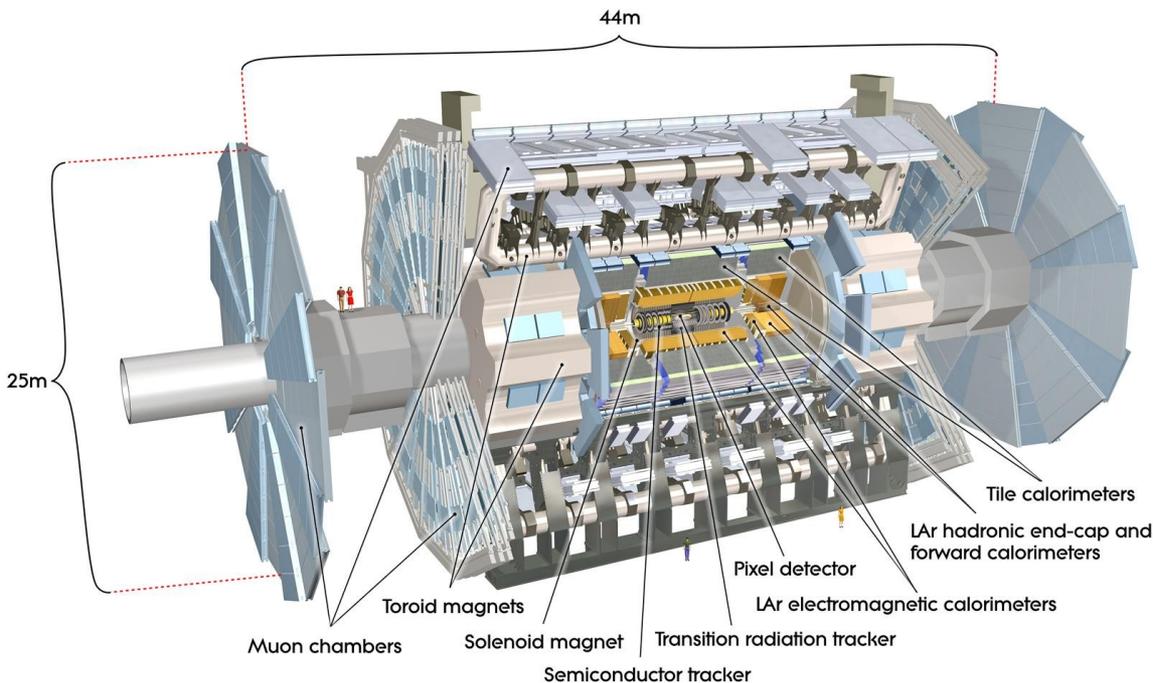
St. Olaf College, Northfield, MN

Sergei Chekanov

Argonne National Laboratory, Lemont, IL

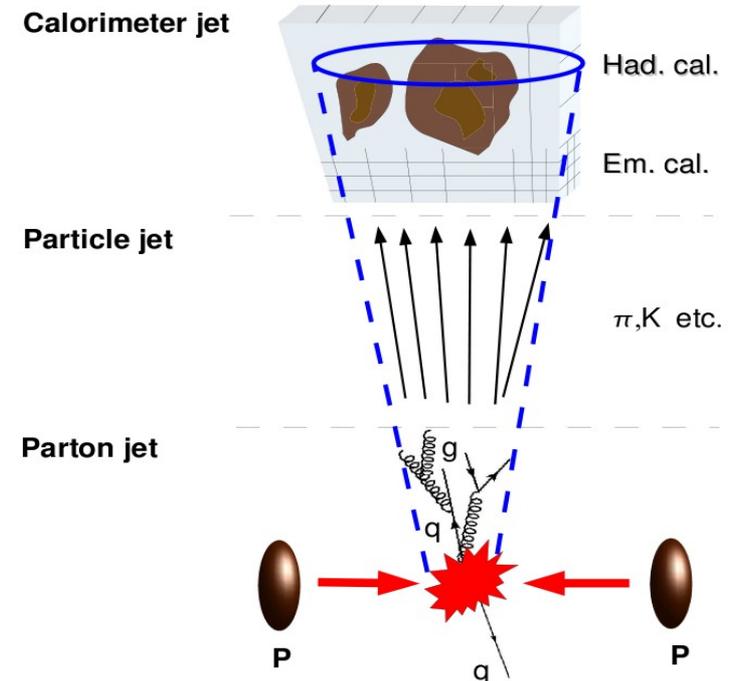
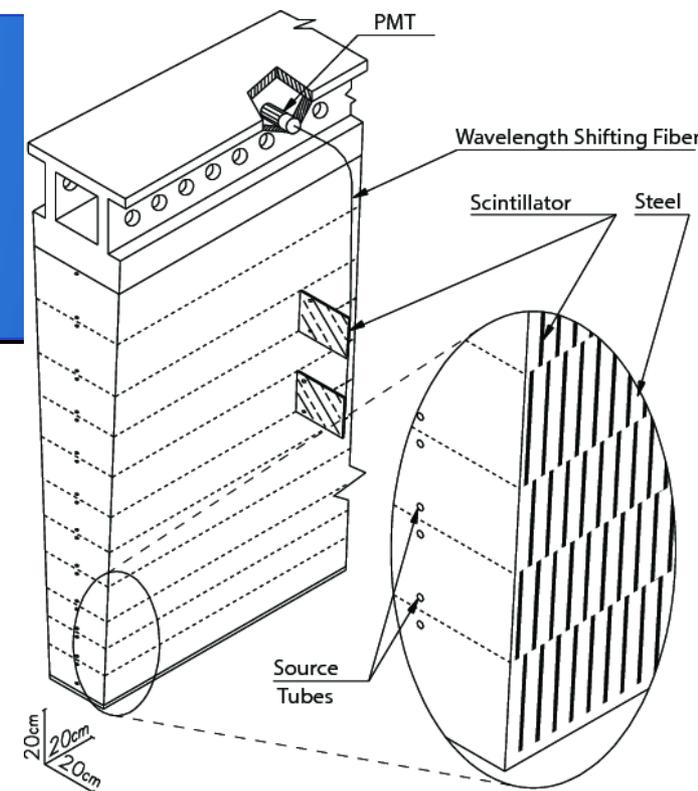
ATLAS Detector

- Part of ATLAS experiment at the Large Hardon Collider at CERN
- Inner detector, calorimeter, muon spectrometer, magnet system



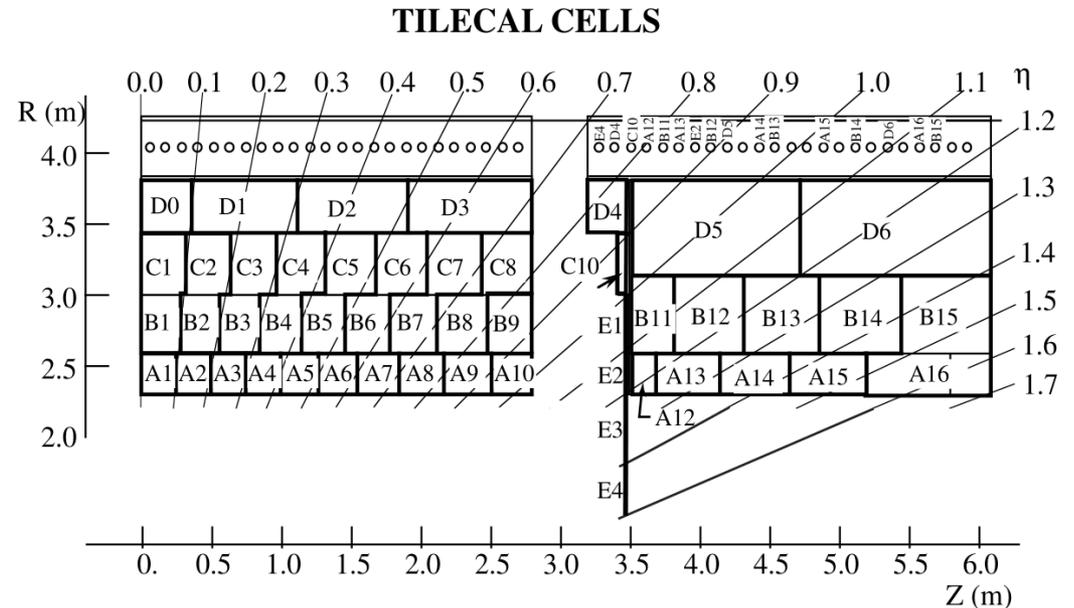
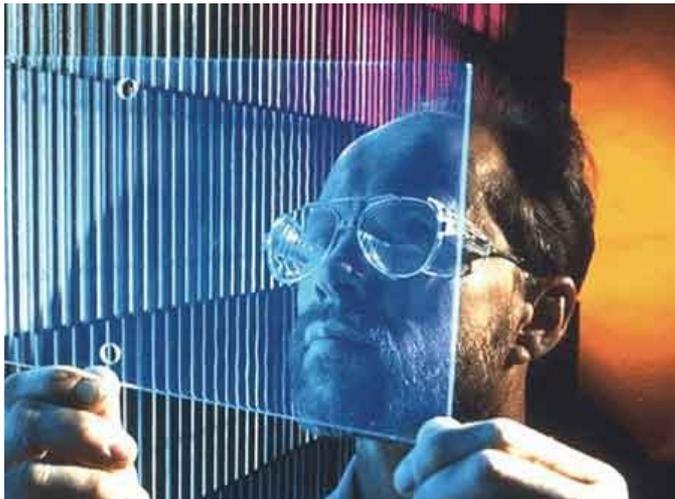
Tile Calorimeter in ATLAS

- TileCal searches for:
 - jet transverse momentum
 - long-lived particles
 - missing energy
 - tau decays
- Plastic scintillator separated by absorbing steel plates
 - Measure up to 1.2 or 1.5 TeV
- A **jet** is a cone of particles that results from quark and gluon fragmentation



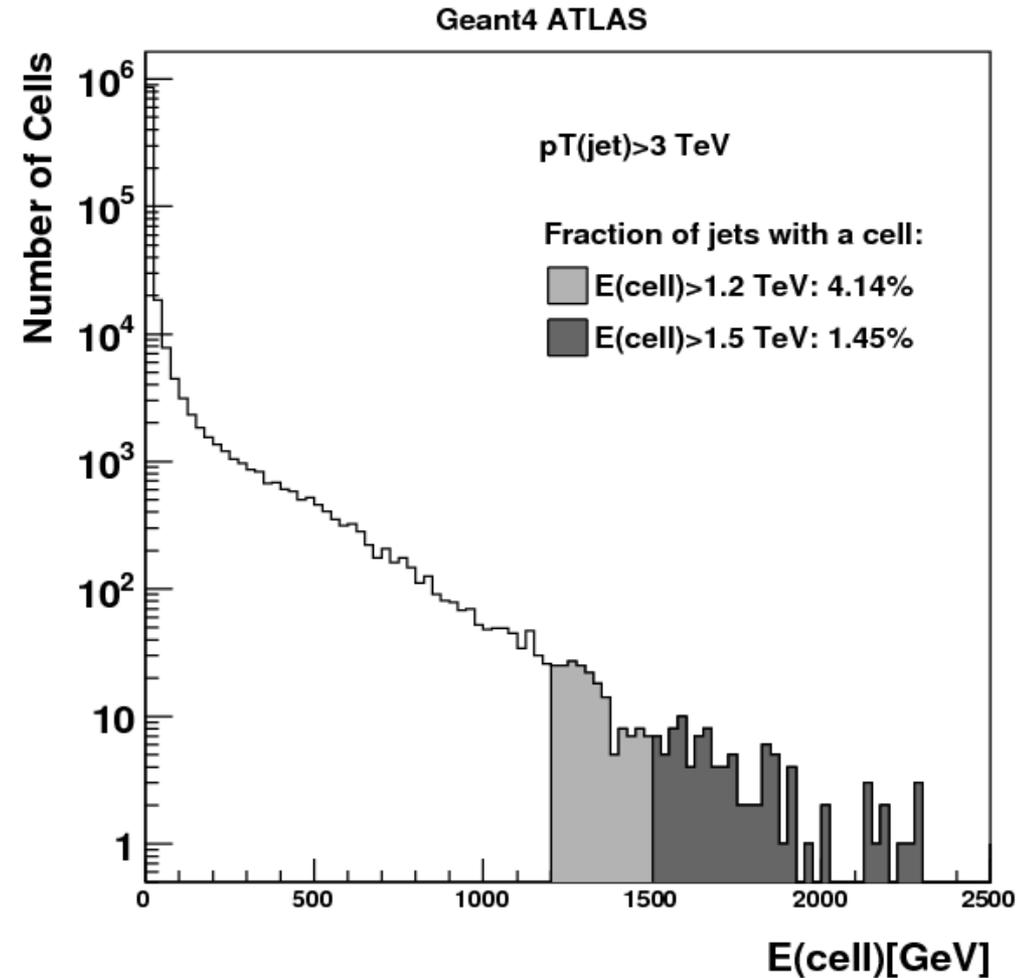
Purpose of Research

- Jet energy can be as large as 4 TeV
- Do we have biases in jet reconstruction due to the limited dynamic range of photo-multiplier tubes and electronics in TileCal?
- Using a full ATLAS simulation, calculate energy ranges for TileCal cells
- Use a fast simulation (x100 faster) for further study



ATLAS full simulation: Dynamic range of cells

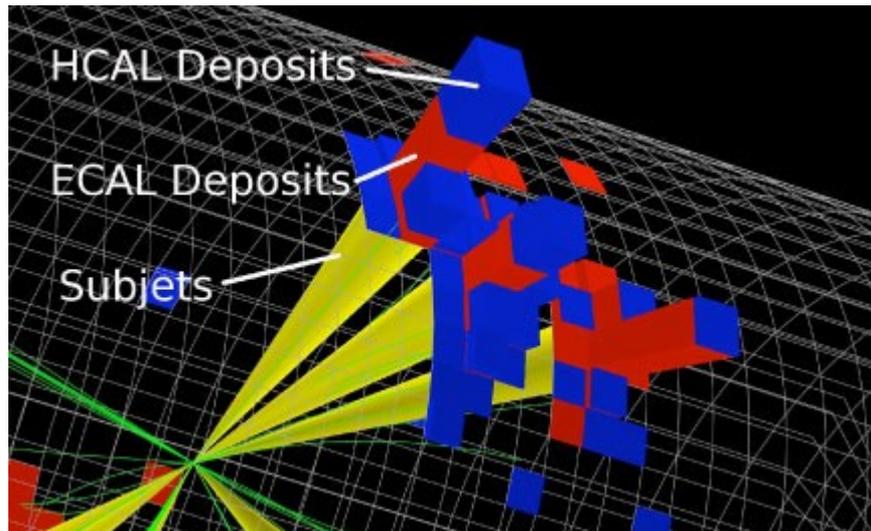
- 14 TeV, Standard Model events
- Dynamic range for 0.1×0.1 cells: Layer A and BC
- Plot shows fractions of jets (in %) that have at least one cell above 1.2 (1.5) TeV



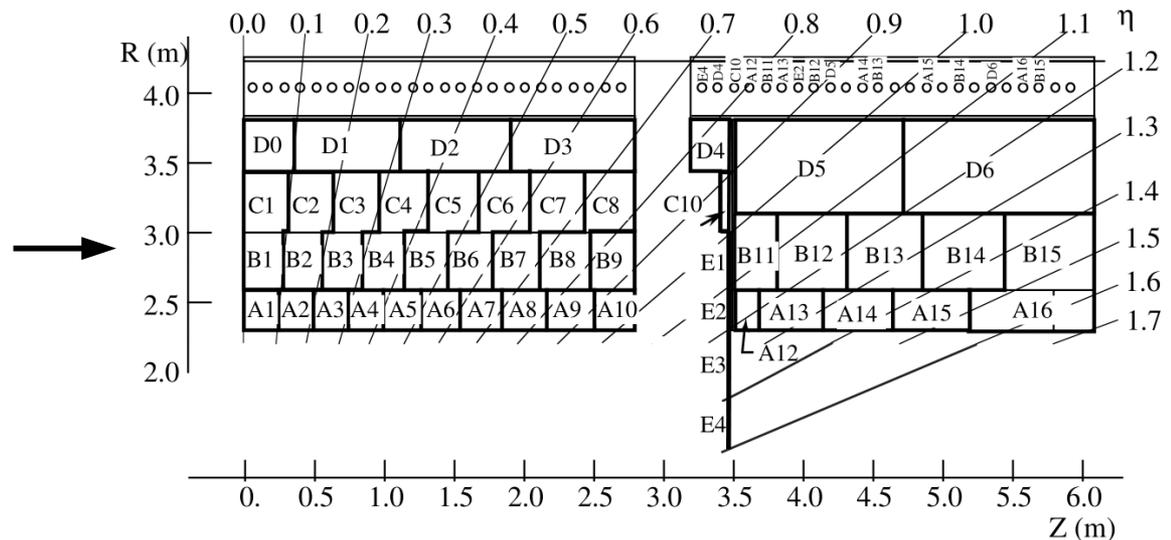
Delphes

- Fast simulation of collider experiment
 - Implements Liquid Argon calorimeter and Tile calorimeter as “towers”
 - TileCal towers have sizes 0.1×0.1
 - Longitudinal cell segmentation needs to be simulated

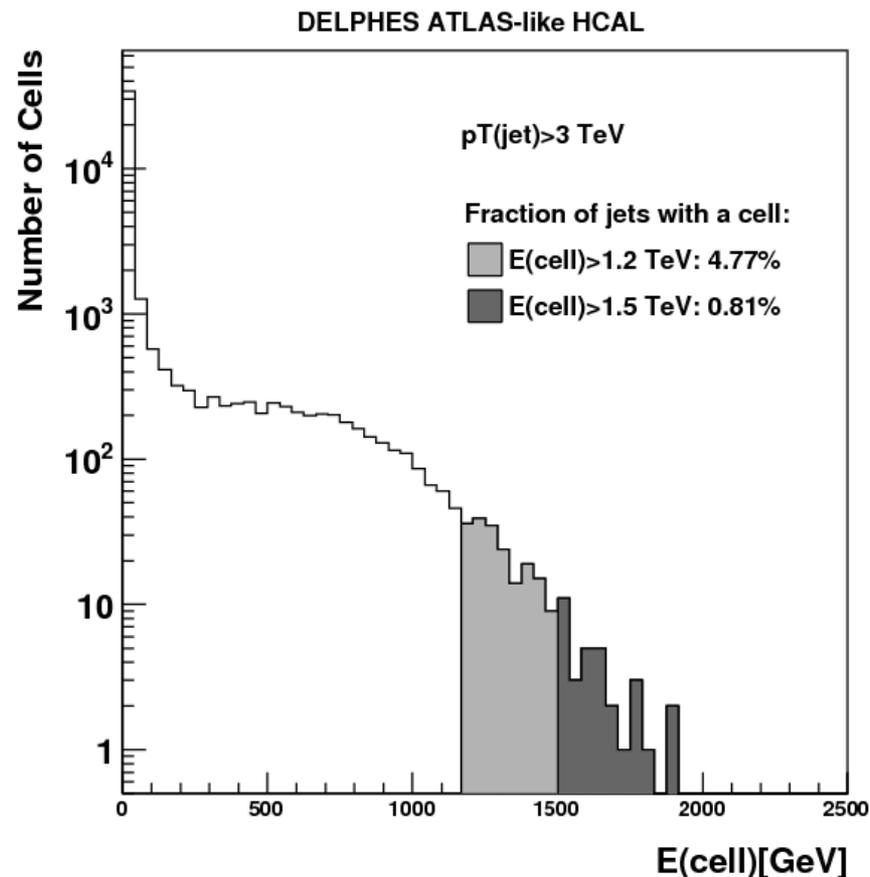
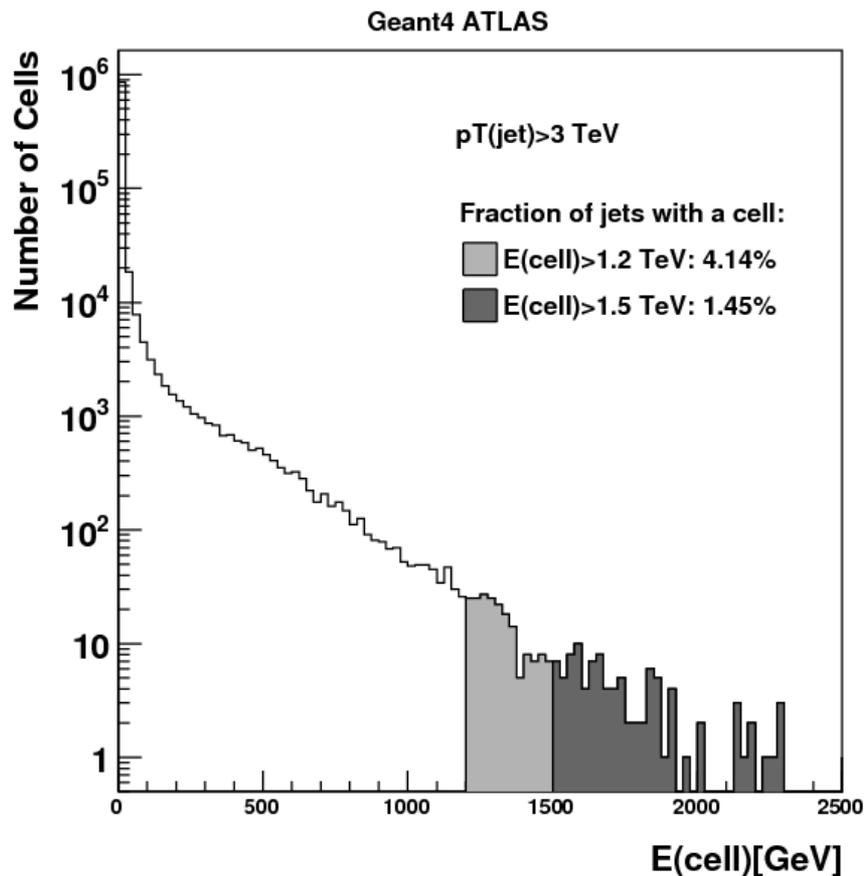
DELPHES TOWERS



TILECAL CELLS



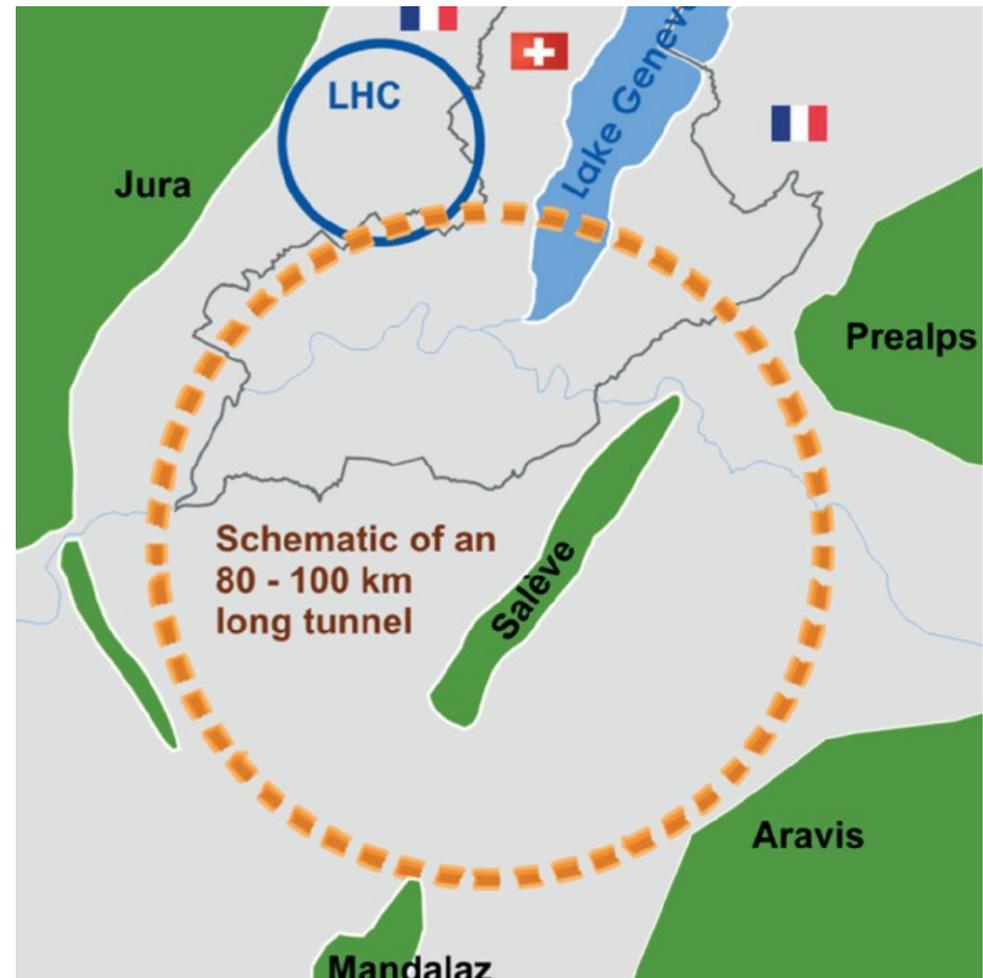
Full simulation vs Delphes



- 14 TeV, Standard Model events
- Plots show fractions of jets (in %) that have at least one cell above 1.2 (1.5) TeV
- Full simulation and Delphes show similar fractions (but shapes are different)

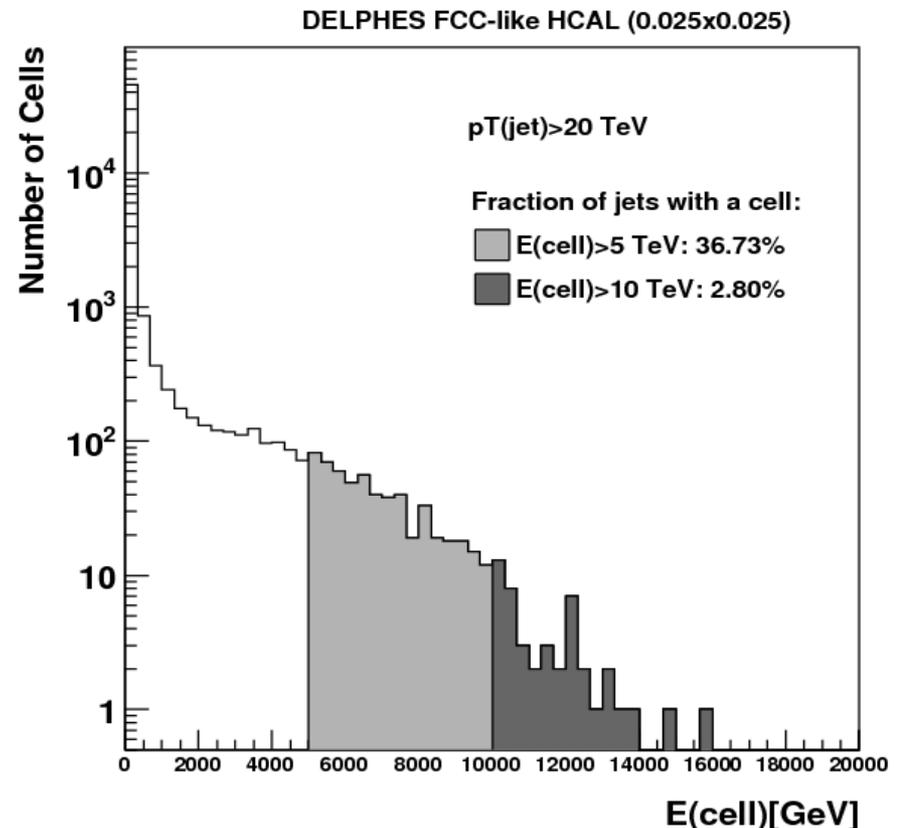
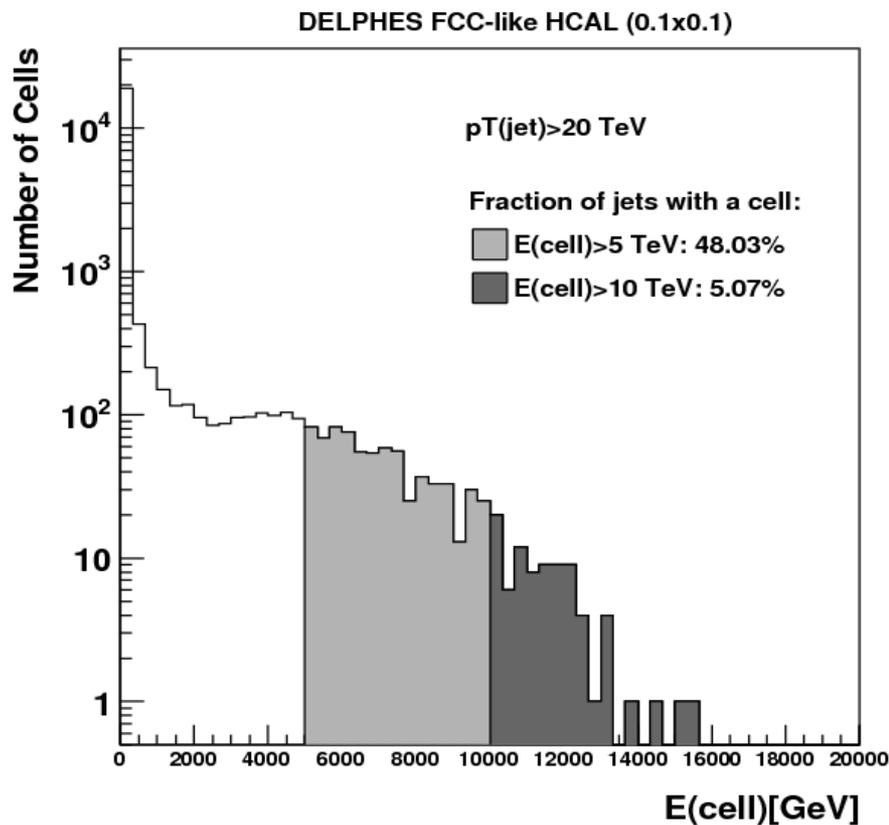
Future Circular Collider (FCC)

- Energy: 100 TeV for proton-proton collisions
- Circumference: 80-100 km
- Necessary detector energy range unknown



FCC Detector

- Dynamic range of cells for 100 TeV, Standard Model events
- Jet $p_T > 20$ TeV



- Dynamic range for 0.1x0.1 cells

- Dynamic range for 0.025x0.025

x4 reduction of cell sizes helps to reduce dynamic range by a factor of ~1.5

Summary

- Energy range of TileCal cells was studied using Standard Model events for LHC and FCC
- Comparable results between Delphes and full simulation
- Effects of dynamic range truncations at 1.2 TeV and 1.5 TeV were quantified
 - Optimistic scenario
- Approximate dynamic range of a FCC calorimeter was obtained

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